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INTERACTION OF SYSTEM APPROACH MODEL AND LESSON DURATION, TEACHERS' QUALIFICATION ON STUDENTS' COMPETENCE IN TECHNICAL SKILLS.

Arikpo Sampson Venatius[1], Aede Hatib Musta'amal[2], Ogumbe Boniface Ekwok[3], Alhaji Modu Mustapha[4].

[1, 2]Department of Technical and Engineering Education, Universiti Technologi Malaysia (UTM), Johor, 81310, Malaysia

[3]Department of Technical and Vocational Education, Cross River University of Technology, 1123 Calabar, Nigeria

[4]Department of Educational Technology, University of Technologi Malaysia (UTM), Johor, 81310, Malaysia

Corresponding Author[1]svarikpo@graduate.utm.my

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ABSTRACT:

The changes, complexity and demands at workplaces requires students to develop competence in technical skills to fit into the current industrial world. This paper examines the effect of the use of system approach model together with lesson duration and teachers' qualification on ST3 students' competence in technical skills. Eighty-nine (89) students participated in the study, out of which 42 assigned to experimental group instructed by the system approach model and 47 assigned to the control group instructed by the traditional approach drawn through a purposive sampling procedure. A well-structured 45-item multiple-choice question titled Competency in Metalwork Trades (CMTs) was used for data collection. Mean, Standard Deviation and Independents sample t-test, ANCOVA statistics using SPSS were employed to analyze the data. The findings of the study indicated that a significant difference exists between the mean of students' achievement in the three aspects of metalwork trades measured to the advantage of the experimental group. The interaction effect between treatment and lesson duration showed that students taught 90mins (double periods) outperformed their counterpart taught in 45mins. Interaction effect between treatment and teachers' qualification showed a systematically equal competence. These results lay evidence that the system approach model (SAM) is efficient in producing competent technical skills graduates for survival in the society making it suitable for teaching in developing nations such as Nigeria.

INTRODUCTION

A plethora of instructional models aimed at providing ways to foster learning, exists in the educational system. Most of these models have improved the way teaching and learning occurs for realizing instructional objectives. The terms instructional model (IM) as being derived from educational technology is coined to mean the practice of creating teaching experiences in a manner that makes knowledge and skill acquisition more efficient, effective and appealing (Behar-Horenstein & Seabert, 2005; Merrill, Drake, Lacy, Pratt, & Group, 1996; Qureshi et al., 2016). It is a systematic approach to the delivery and evaluation of instruction through a flowchart-like pattern for describing and understanding complex content. The hallmark of education is to create a lasting change in learners' behavior through the process of training in a formal setting. To acquire a technical task, learners' needs to be guided through a systematic process that allows for organizing information in a hierarchy to foster complex learning skills. (Van Merriënboer, 2007) maintains that each task must have an integrate sets of learning goals and performance objectives. Using instructional model strengthens four core teaching characteristics (i) uniformity in teaching contents for a subject area (Uwaifo & Uwaifo, 2009) (ii) stimulate innovations in teaching strategies and tactics (Nicholls, Sweet, Muller, & Hyett, 2016) (iii) improved lesson delivery by helping learners get only relevant information(Behar-Horenstein & Seabert, 2005). Additionally, it enables teachers to visualize training need and break down the process of designing training material into steps. These distinguishes the adoption of instructional models from the traditional method used by teachers in schools to teach skills.

System approach model is a new and popular instructional model like ADDIE, Kamp design models among others, which were devised to improve instructional delivery. It employs a systematic approach in teaching and has since been used at different educational levels in engineering, medical, education, military among others (Miller, 2005). Sequencing workshop activity is appropriate for teaching complex skills in technical institutions (Rogers, 1982) and it is depends on the nature of the learning task and it fits into what is to be taught. The four step model of (Walker & Peyton, 1998) and five step model of (George & Doto, 2001) laid evidence that technical skills are learnt in steps from simple to complex. Learning skills requires a system which focuses on the interaction between context, content, learning and instruction and viewed the instructor, learners and materials components that interact with each other to work together to bring about the desired learning outcomes in students. With a proper instructional procedure, technical education students can learn, practice, understand the complexity and follow a sequential order until perfection is attained. The SAM framework task analysis limits the number of skills taught in any one teaching session to a range of nine steps required to for cognitive overload (Leppink & van den Heuvel, 2015). Besides, the instructional approach an educator can use to inculcate technical skills should be effective to identify the instructional teaching goals, determining the skills that students will need to learn in the topic, check students entry behaviour by assessing the skills the students already have out of those that were previously determined as needed for the present lesson. (Leppink & van den Heuvel, 2015) also, identify the specific goals and objectives, demonstrate activities and decide how each segment will be perform and conducts a formative evaluation in the process of the lesson and summative evaluation at the end.

Lesson duration is not a new concept in education and researches have been carried out on topics relating this variable with students' educational gain. (Foy & Evans, 2008; Padelford, 1984; Simpson, 1972) are some psychomotor skill teaching models proponents who concurred that proper timed is of essence when dealing with psychomotor skills. Practice session's duration together with task

sequence learning opportunities encourages the process of skill encoding, mastering and retention (DeBourgh, 2011; Kantak & Winstein, 2012). This suggest that inculcating technical skills requires duration and task practice opportunities to acquire skills and retention. This assertion corroborate the contemporary reports of (Cattaneo, Oggenfuss, & Wolter, 2017) whose findings suggest that the effectiveness of instructional time differs between learners ability and that additional instruction time significantly increases the within-school variance of a particular subject test scores. (Hincapie, 2016) examined international gaps in student achievement to ascertain the effects of instructional time using PISA 2006 data. The findings show a significantly positive effect of instructional time on test scores. The author provided an overview according to countries showing that the effect is lower in developing countries. In a related study, (Kidron & Lindsay, 2014) carried out a meta-analysis by reviewing across the 30 studies to examine the effect of increased learning time on student academic. The result demonstrates that (i) increased learning time improved literacy and math achievement when certified teachers led the instruction. (ii) effects varied by type of instruction (traditional instruction style and experiential learning instruction style) and (iii) learning time improved achievement of students performing below standards. In another development, (Yeşil Dağlı, 2019) assessed the effect of increased instructional time on students' achievement and uncovered that while there is a positive association between allocated instructional time and achievement, classrooms composition mediate on the effect of additional instructional time. Similarly, (Archer, van Hoving, & de Villiers, 2015) could not identified any significant differences in skill acquisition and retention after two months when they compared 3, 4 and 5 steps skill teaching models in performing manual defibrillation of a manikin with ventricular fibrillation .

Likewise, research studies relating to teachers' qualification have been reported with mix findings. (Dodeen, Abdelfattah, Shumrani, & Hilal, 2012; Esuh, 2013; Fred & Tamale, 2013; Holland, 2011; Jega & Julius, 2018; Maphoso & Mahlo, 2015; Odinko, Williams, & Donn, 2009; Owolabi & Adedayo, 2012) results indicate that students taught by teachers with higher academic qualifications outperformed their counterparts taught by teachers having lower academic qualifications. On the contrary, (Moosa & Shareefa, 2019b) did not show a difference in teachers' knowledge of implementation of instructional model based qualification.

The effective use of an instructional model should guarantee a better outcome in students' achievement. It is obvious from reviewed literature that despite the adoption of most psychometric skills models by teachers, students are face with the problem of abysmal performance in technical skills. The goal of technical education is to bring learners to a point where they have to acquire skills, attitudes and knowledge through an active learning process. This will make them retain information and facts for self-reliant. Research shreds of evidence abound of factors affect students learning in practical subjects (Mwangu & Sibanda, 2017). As season teachers, we understand that certain variables impede learning outcome. We suspected that lesson duration and teachers' qualifications are factors, which if properly handled together with the instructional model would influence students' academic outcome.

The thrust of TVET is not all about knowledge or facts building, but also as the practice and command of learners' ability to solve societal problems after training. Technical skill competence enhances students' chance of actualizing TVET goal of being self-employed and self-reliant (Seymour, Everhart, &

Yoshino, 2015). The acute skill deficiencies among students graduating from vocational institutions in Nigeria demonstrate clearly that students lack the know-how and capabilities to perform technical task using appropriate equipment and tools properly (Medina, 2010; Nasir, Ali, Noordin, & Nordin, 2011). It thus appears that teaches might be teaching technical skills without use of any scientific instructional procedure and/or some variables might be affecting their teaching approaches. It becomes imperative to remove the clog in the wheel of progress towards technical competence by examining the interactive effect of some identified factors with the System Approach Model. Against the backdrop to improve teaching towards TVET graduates technical skill competence, this paper is guided by the following research questions.

- Is there any significant difference between the mean scores of students taught with system approach model and those taught with the traditional methods in metalcraft practice?
- Is there any significant difference between the mean rating of technical skill competence in metal fabrication of students taught for 45min and 90min using system approach model?
- Is there any significant difference between the mean rating of technical skill competence in machine operations of students taught by HND/BSc and MSc./PhD holders using system approach model?
- What is the interaction effect of use of system approach model and lesson duration on students' mean technical skill competence?
- What is the interaction effect of use of system approach model and teachers' qualification on students' mean technical skill competence?

RESEARCH METHODOLOGY

Methods and Data

The study employed the quasi-experimental design. The intact classes ST3 were randomly assigned to system approach model and to different treatment conditions (Moderators). Metal fabrication was a practical based subject that explore demonstration, field trips, project based learning and lecture method. Students actively participated in metal fabrication class using tools, equipment and guided by the system approach model. The scores of the experimental and control in the subjects where used to determine whether they exist any significant difference between students' scores. Based on our observation of the training, we hypothesized that using system approach model to teach technical skill competence in metal fabrication would have no interaction effect with lesson duration and teachers' qualification.

Sample

All participant were metalwork technology senior technical three students offering metal fabrication in 2019/2020 academic session. The propulsive sampling strategy was employed to select two technical colleges from Calabar Metropolis. This was to enable us capture colleges where students are being taught the subject by teachers with different qualifications and duration. The reason for purposive techniques was to make sure that teachers have required experience in teaching (teacher effect). One technical colleges was assigned to experimental group and the other control group.

Procedure

Students were introduced to three aspects of practical skills in metal fabrication through system approach model. The system approach model was used together with instructional strategies that allows students to participate in field trip to nearby industries. The training period took four weeks with lesson holding twice per week to cover four topics in metal fabrication. The experimental class was taught by MSc/PhD holders in 90min (double period) per lesson period. Whereas, teachers with HND/BSc taught the control group in 45min per lesson period. This qualifications and time are the traditionally predominant requirement for teaching of skills contents in colleges. Treat to internal validity issues like teacher factor, experimental bias, test effect, novelty effect among others were all assumed to be resolved. Prior to the actual execution of the study, all the materials needed for the lessons were provided, which was used to implement the treatment. Teachers in the experimental group were trained in the use of the system approach model to enable us examine its effects on the traditional approach group. In effect, a post-test was administered to both students.

Research Instrument

A multiple-choice achievement test in metalwork trade titled "Competency in Metalwork Trades" CMTs, was developed by the researchers in accordance with the curriculum objectives. The test comprised of forty-five multiple-choice questions (fifteen each from the three aspects examine) having four answer options. Two experts in technical education and measurement determined the face, construct and content validity. Before administration, we subjected the items to item analysis to identify and correct issues of item difficulty and discrimination indices and factor analysis to drop items due to poor loading. This reduced the initial 54 items to 45 used in the study. The refined version of the 45 items was pilot tested and undergone test of stability and internal consistency using the K-R_{20}. A reliability coefficient of 0.78 was obtained and considered suitable for the study.

Statistical Analysis

The data generated were analyzed using Independent samples t-test statistics, ANCOVA using SPSS and mean and standard deviation statistics.

RESULTS

Results Oof Pre-Treatment

Mean and standard deviation were used to analyze the results of 2018/2019 third term class examination scores of the students involved to determine if they exist any initial difference between the groups investigated. The results shows difference in achievement with the 90min (double period) class having (Mean = 11.29, SD = 1.86) and the 45min class (single period) having (Mean = 9.93, SD = 1.22). While, qualification shows no difference in students achievement with taught by MSc/PhD holders had (Mean = 12.71, SD = 2.62) and the HND/BSc (Mean = 12.06, SD = 1.94). However, it was found out that students scores based on lesson duration but no difference based on qualification.

Results of Post-Treatment

In Table 1, data were subjected to an independent-samples t-test to compare students' technical skills competence in metalcraft practice using system approach model. There was a significant difference in the scores for experimental with (Mean = 16.57, SD = 5.54) and control (Mean = 13.90, SD = 3.88) groups, t (87) = 2.614 at p = 0.011. These results suggest that system approach model does have an effect on students' technical skills competency. This imply that

students are taught using system approach model will be properly equip with the knowledge to perform technical task.

Table 2, shows the time wise post-scores comparison of experimental and control groups in metal fabrication. Data were subjected to an independent-samples t-test to compare students' technical skills competence based on lesson durations using system approach model. Significant difference was found in the scores for experimental with (Mean = 14.52, SD = 3.09) and control (Mean = 12.01, SD = 2.38) groups, t (87) = 1.905 at p = 0.060. These results suggest that lesson duration have an effect on students' technical skills competency. We concluded that when students are taught for longer period, they acquire more skills and their knowledge to perform technical task increases.

The result in Table 3, shows the qualification wise post-scores comparison of experimental and control groups in machine operations. The data generated in the study were subjected to an independent-samples t-test to compare students' technical skills competence in metalcraft practice using system approach model. There was a significant difference in the scores for experimental with (Mean = 13.83, SD = 4.10) and control (Mean = 11.22, SD = 2.93) groups, t (87) = 1.003 at p = 0.901. These results implies that system approach model have systematically equal effect on students' technical skills competency based teachers' qualification. Therefore, we concluded that teachers' qualification does not a factor that impeded students' acquisition of technical skills.

Table 4, presents the interaction effect of use of system approach model and lesson duration on students' mean scores in technical skills using CMTs. The results F-val (2, 87) = 2.001, p-val = 1.102 revealed that there was significant effect of interaction between the treatment and lesson duration in achievement in technical skills. The Post-hoc comparisons using the Turkey HSD test indicated that students' taught for 90min had (Mean = 14.52, SD = 3.09) while those taught for 45min had (Mean = 12.01, SD = 2.38) in favour of the 90min group. We concluded that when students are giving more time to learn complex skills they tend to be more competent in technical skills.

The data presented in Table 5, shows the interaction effect of use of system approach model and teacher's qualification on students' mean scores in technical skills using CMTs. The F-val (2, 87) = 1.036, p-val = 2.883 indicated that there was on significant effect of interaction between the treatment and teachers qualification in students' achievement in technical skills. This imply that the score for students' taught by MSc/PhD holders was not better than the score of students taught by HND/BSc holders in achievement in technical skills. We concluded that teachers' qualification do not affect students' competency in technical skills.

Table 1: Post-scores comparison of experimental and control groups in metalcraft practice

Group	N	Mean	SD	Df	t-value	p-value	Effect size
Experimental	42	16.57	5.54	87	2.614*	0.011	0.87
Control	47	13.90	3.88				

*Significant at 0.05 alpha level

Table 2: Time wise post-scores comparison of experimental and control groups in metal fabrication

Group	N	Mean	SD	Df	t-value	p-value	Effect size
90min	42	14.52	3.09	87	1.905*	0.060	0.93
45min	47	12.01	2.38				

*Significant at 0.05 alpha level

Table 3: Qualification wise post-scores comparison of experimental and control groups in machine operations

Group	N	Mean	SD	Df	t-value	p-value	Effect size
MSc/PhD	42	13.83.	4.10	87	1.003	0.901	0.96
HND/BSc	47	11.22	2.93				

Significant at 0.05 alpha level

Table 4: What is the interaction effect of use of system approach model and lesson duration on students' mean scores in technical skills?

Source of Variance	Sum of Square	DF	Mean Square	F-val	Sign of Decision
Covariates	141.912	1	141.912	0.765	0.108
Pretest	141.912	1	141.912	0.765	0.108
Main effect	47117.856	2	23558.928	126.982	0.000
Treatment level	46779.838	1	46779.838	2.001*	1.102
Lesson duration	338.017	1	338.017	1.822	0.029
2-way interaction	118.179	1	118.179	0.127	0.130
Treatment x Duration	118.179	1	118.179	0.127	0.130
Explained	47354.213	4	11838.553	63.842	0.000
Residual	23655.037	84	281.608		
Total	71009.250	88	806.923		

*Significant at 0.05 alpha level

Table 5: What is the interaction effect of use of system approach model and teachers qualification on students' mean scores in technical skills?

Source of Variance	Sum of Square	DF	Mean Square	F-val	Sign of Decision
Covariates	43.742	1	43.742	0.299	0.220
Pretest	43.742	1	43.742	0.299	0.220
Main effect	24280.867	2	12140.434	102.592	0.000
Treatment level	16174.199	1	16174.199	1.036**	2.883
Qualification	39.135	1	39.135	0.206	0.125
2-way interaction	91.752	1	91.752	0.326	0.016
Treatment x Qualification	103.692	1	103.692	0.004	0.018
Explained	16408.778	4	4102.175	27.728	0.000
Residual	18676.965	84	222.343		
Total	35085.743	88	398.702		

**Not significant at 0.05 alpha level

DISCUSSION AND CONCLUSIONS

Evidences from this study suggests that utilizing system approach model in classroom has a significant effect on students' achievement and competency in technical skills. Students who were taught using System approach model had better achievement scores than their counterparts who were not taught without the use of system approach model. This approach to teaching is in tandem with resent calls to the importance and benefits of inculcating skills in trainers through a more realistic experience when teaching technical skills (Kneebone et al.,

2006). The findings of this study is consistent with the findings of early studies of(Davies & Hamdorf, 2003; Fleming, Motamedi, & May, 2007; Nicholls et al., 2016; Prince & Felder, 2007; Walker & Peyton, 1998) who found teaching through a systematic guide to be very productive, but in contrast with the finding of (Samuelsson, 2010) who concluded that model of teaching do not significantly differ the student's proficiency in skills. The variation in this result might be because better understanding of the activities and processes involved in the model by students tends to stimulate their knowledge in the subject.

We examined the effect of this model of teaching on the time allotted for teaching practical to students. We found out that the duration of time teachers engages students in practical using the system approach model increases their achievement significantly. This means that if students are giving more time to learn activities they will competent in them. This result is consistent with the previous research works of (Custers, Regehr, McCulloch, Peniston, & Reznick, 1999; Kidron & Lindsay, 2014; Maphoso & Mahlo, 2015; Paus et al., 1997) but, not in line with the findings of (Archer et al., 2015; Yeşil Dağlı, 2019) suggesting that increase in the duration for teaching and learning complex skills will have positive effect on students achievement and competence. However, the teachers' qualification wise comparison shows that there is no significant difference between the achievement scores of students taught by MSc/PhD and HND/BSc holders. This finding supports the work of (Moosa & Shareefa, 2019b) did not show a difference in teachers' knowledge of implementation of instructional model based on qualification. But, disagreed the reports of (Dodeen et al., 2012; Esuh, 2013; Holland, 2011; Jega & Julius, 2018; Maphoso & Mahlo, 2015; Odinko et al., 2009) that previously indicated that the students taught by teachers with higher academic qualifications performed than those of teachers with lower academic qualifications.

We investigated the effect of interaction of treatment and lesson duration. The result shows that there was significant interaction effect of treatment and students' competency in technical skills. This imply that students' taught for 90min and those taught for 45min had marginal effect difference in achievement in technical skills as a result of interaction of treatment and duration of lesson. This result was expected because both teachers and students in the 90min group had more time to manipulate tools and equipment in learning each activity and step. The variation in duration of teaching might have caused different opportunity of involvements practice thereby causing interaction effect between the treatment and lesson duration. This finding consistent with (Cornford, 2008; Foy & Evans, 2008) who asserts that sequencing the practicing of complex skills enables the correct skills to be taught and maximal use of skill teaching time, which can influence educational outcomes.

Another concern was to examine that effect of interaction of the treatment and teachers' qualification, which shows systematically equal achievement scores. This means that there is no significant difference of treatment between students' taught by teachers MSc/PhD and HND/BSc degree holders on students' achievement in technical skills. This result was expected because having qualification alone does not equate teaching experience and being a professional in teaching with the skills to impact knowledge. This finding confirms the earlier finding of the research work of (Moosa & Shareefa, 2019a).

It is believe that learning of psychomotor skills requires a teaching approach, which can properly guide and develop technical skill acquisition. Contemporary literatures suggests that teaching technical skills through a model of teaching will

foster better understanding of practical content, boast students' competence and alleviate poverty. The system approach model has been used and found useful in many disciplines and countries. We feel it can be useful to students of TVET programme in developing countries like Nigeria to ease their learning of practical complex tasks.

CONFLICT OF INTEREST

The authors declares no conflict of interest

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